

AMENDMENTS TO THE DRAWINGS

The attached sheet(s) of drawings includes changes to Figures 2 and 9.

Attachment: Replacement sheet
Annotated sheet showing changes

REMARKS

I. Summary of Office Action

The drawings were objected to as failing to comply with 37 C.F.R. §1.84(p)(4).

Claims 87, 88, and 90 were objected to as allegedly depending on a nonelected claim.

Claims 51, 92, and 122 were rejected on the ground of nonstatutory obviousness-type double patenting over claim 1 of U.S. Patent No. 5,985,232 (hereinafter “Howard ‘232”).

Claims 54-56 and 89 were rejected under 35 U.S.C. §112, first paragraph as failing to comply with the enablement requirement.

Claims 55-59, 70, and 81 were rejected under 35 U.S.C. §112, second paragraph as being indefinite.

Claims 51, 91, and 122 were rejected under 35 U.S.C. §102(b) over Howard ‘232.

Claims 51-55, 59-53, and 122 are rejected under 35 U.S.C. §103(a) over Howard ‘232 in view of Applicants’ admissions.

Claims 57, 58, 66, and 67 were rejected under 35 U.S.C. §103(a) over Howard ‘232 in view of Greico et al. “Fullerenic carbon in combustion-generated soot,” 38 Carbon 596 (2000) (hereinafter “Greico et al.”).

II. Amendments

The specification has been amended to make the specification consistent with the reference character identifiers in the drawing. No new matter is believed to have been added.

Claim 93 is canceled. Claims 1-9, 11-26, 29-34, 37-62, 64, 66-72, 74, 76-81, 83, 85, 86, 89-93, 117-120, and 122 are amended. Support for the amendments is found throughout the originally-filed claims and specification. No new matter is believed to have been added.

III. Objections to the Drawings

Applicants thank Examiner McCracken for the careful review of the drawings and specification and pointing out minor clerical errors. Replacement drawings are being submitted herewith to address the Examiner's objections. Figure 2 adds reference identifier 275 and Figure 9 replaces a second instance of the reference identifier 900 to reference identifier 920. Accordingly, Annotated Sheets (marked-up copy of the drawing) are not be submitted herewith (see MPEP 608.02(v)). Withdrawal of the objections is requested.

IV. 35 U.S.C. §112, First Paragraph Rejection

Claims 54-56 and 89 were rejected under 35 U.S.C. §112, first paragraph as allegedly failing to comply with the enablement requirement. Applicants respectfully disagree.

Claim 54 is directed to a method for processing fullerenes wherein separating at least a portion of the suspended soot particles from the gas stream is conducted under conditions of fullerene stability. Claim 55 further specifies that conditions of fullerene stability comprise conditions where consumption of fullerenes by the suspended soot particles or other species contained in the gas stream is minimized. Claim 56 requires that the time-scale of said separating is small relative to the time-scale of said consumption of fullerenes by soot particles or other species. Claim 89 requires that the PAH content of the condensable gases is reduced by reacting of the PAH with soot particles.

As stated in the Office Action, “[t]he analysis for determining whether a claim is supported by the disclosure is cast in terms of whether ‘undue experimentation’ is necessary to practice the invention.” (Page 5 of the Office Action). Applicants respectfully note that “[t]he fact that experimentation may be complex does not necessarily make it undue, if the art typically engages in such experimentation.” (MPEP §2164.01 *citing In re Certain Limited-Charge Cell Culture Microcarriers*, 221 USPQ 1165, 1174 (Int'l Trade Comm'n 1983), *affd. Sub nom. Massachusetts Institute of Technology v. A.B. Fortia*, 774 F.2d 1104 (Fed. Cir. 1985)). Moreover, “[a]s long as the specification discloses at least one method for making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, then the

enablement requirement of 35 U.S.C. 112 is satisfied.” (MPEP §2164.01(b) *citing In re Fisher*, 427 F.2d 833, 839 (CCPA 1970)).

Applicants provide the following comments to the *Wands* factors outlined in the Office Action (see pages 6-8 of Office Action).

a. The breadth of the claims

Applicants respectfully submit that the Office has not presented any explanation why claims 54-56 and 89 are broadly draft. The Office Action merely points out references to certain limitations in the claim but do not explain why they are broad. Moreover, Applicants note that claims 54-56 and 89 are all dependent claims, which necessarily have narrower scope than the independent claim(s) from which they depend on.

b. The nature of the invention

Applicants agree that the invention as a whole is drawn to a method for producing fullerenes and separating them.

c. The state of the prior art and the level of one of ordinary skill

Applicants agree that the references provided by Applicants as well as those cited by Examiner are indicative of the level of ordinary skill in the art.

d, e, and g. The level of predictability in the art; the amount of direction provided by the inventor; the quantity of experimentation needed to make or use the invention based on the content of the disclosure

Applicants again note that “[t]he fact that experimentation may be complex does not necessarily make it undue, if the art typically engages in such experimentation.” (MPEP §2164.01 *citing In re Certain Limited-Charge Cell Culture Microcarriers*, 221 USPQ 1165, 1174 (Int'l Trade Comm'n 1983), *affd. Sub nom., Massachusetts Institute of Technology v. A.B. Fortia*, 774 F.2d 1104 (Fed. Cir. 1985)).

In regards to claims 54 and 55, Applicants direct the Office's attention to page 21, lines 4-14 and page 34, line 17 through page 35, line 13 of the specification. As described therein, conditions of fullerene stability can be obtained by controlling variables such as burner chamber pressure, fuel and oxidant flow rates, gas velocities, and phi (defined by the relationship ((actual fuel/oxidant)/(stoichiometric fuel/oxidant))). Figure 10, in particular, shows a graph taken from Richter et al., *Combustion and Flame*, 119:1 (1999), which was submitted in the information disclosure statement dated April 18, 2006. As described, the graph can be utilized for locating the points of fullerene stability, and “[t]he change in concentration from the optimal to sub-optimal distance above a burner can be the result of, for example, consumption reactions reducing the concentration of fullerenes.” (Page 35, lines 7-9 of specification).

Additional description to control the desired degree of chemical consumption reaction of fullerenes, for example, by operating the separation on a time-scale shorter than the consumption reactions are provided, as claimed in claim 56. For example, the specification teaches separation can be carried out on a time-scale shorter than the consumption reactions by controlling the cooling of the gas effluent, by adding a diluent, or rapid cooling of the gas effluent. (See page 35, lines 14-18). Rapid filtration, electrostatic separation, or electrostatic precipitation can also be utilized. (See page 35, lines 19-23 of specification).

Furthermore, “[e]xemplary conditions for the reduction of PAH content in the gas stream, growth of soot particles, and formation of fullerenes include residence times in the transfer zone in the range of about 10 ms to about 10 s, or about 100 ms to 2 s, and temperatures in the range of about 500 °C to about 2200 °C, or in the range of about 900 °C to about 1700 °C.” (Page 15, line 23 to page 16, line 3 of specification).

f. The existence of working examples

Moreover, the Examples provide detailed exemplary description of the separation and collection of fullerenes from soot and PAH (see, e.g., Example 1 at pages 38-42). Detailed system and operating parameters are provided in these Examples. For example, in Example 1, approximately 95% of the soot present in the gas stream was separated by the separator with the mentioned system and operating parameters (page 39, lines 14-15). Moreover, with the provided

system and operating parameters, the collected fullerenes were approximately 99% pure with respect to PAH, which was attributed to the residence time and temperature provided in the conduit between the combustion chamber and the soot filter. (Page 40, lines 1-5). Applicants submit the detailed system and operating parameters provided in these Examples bears a reasonable correlation to the entire scope of the claims and, hence, discloses at least one method of making and using the invention as claimed in claims 54-56 and 89.

Accordingly, Applicants have provided detailed description from the specification teaching how to carry out the claimed invention, evidence that one of ordinary skill in the art typically engages in such experimentations, and at least one exemplary method that bears a reasonable correlation for making and using the claimed invention. Hence, Applicants submit the enablement requirement of 35 U.S.C. 112 is satisfied. Reconsideration and withdrawal of the rejection is requested.

V. 35 U.S.C. §112, Second Paragraph Rejection

Claims 55-59, 70, and 81 were rejected under 35 U.S.C. §112, second paragraph as allegedly being indefinite. Applicants submit that the amendments to claims 55, 57-59, 70, and 81 render the rejections to these claims moot.

However, in claim 56, Applicants point out that the “[t]he fact that claim language, including terms of degree, may not be precise, does not render the claim indefinite.” (MPEP 2173.05(b) *citing Seattle Box Co., v. Industrial Crating & Packaging, Inc.*, 731 F.2d 818 (Fed. Cir. 1984)). “Acceptability of the claim language depends on whether one of ordinary skill in the art would understand what is claimed, in light of the specification.” Claim 56 recites the term “small.” However, Applicants submit one of ordinary skill in the art would readily recognize the scope of the claims as the claim clearly requires that the time-scale of said separating is small relative to the time-scale of said consumption of fullerenes by soot particles or other species. In other words, one of ordinary skill in the art would readily recognize that consumption of fullerenes by soot particles or other species is not occurring to a significant extent in the claimed method.

VI. Nonstatutory Double Patenting Rejections

The Office Action asserts that claims 51, 91, and 122 would have been obvious to one of ordinary skill in the art because Claim 1 of "Howard '232 describes gas/solid separation techniques" (page 4 of Office Action), and points to col. 7, lines 62-65 of Howard '232, which states "[c]onventional collection techniques such as bag filtration, electrostatic separation and cyclone separation are also within the scope of the invention. Applicants respectfully disagree.

Howard '232 teaches separating a solids from solids, solids from liquids, or liquids from liquids. Howard '232 does not teach separating a gas stream comprising gaseous fullerenes from suspended soot particles (solids), as required by the claims.

Claim 1 of Howard '232 recites:

A method for the production of fullerene nanostructures,
comprising:

combusting an unsaturated hydrocarbon fuel and oxygen in a non-arc-discharge burner chamber at a sub-atmospheric pressure,
thereby establishing a flame;

collecting condensables of the flame at a post-flame location, the condensables comprising fullerene nanostructures and soot, the fullerene nanostructures having the composition C_n , where $n \geq 100$; and

separating the fullerene nanostructures from the soot.

Col. 3, lines 44-46 explicitly define the term "condensables" as being "a product of the combustion process *which is collected as a solid or liquid from the flame.*" These can include vapors "*which are collected as they exit the flame,*" for example, by rapid quenching into a solid

or liquid (col. 3, lines 49-51). Claim 1 of Howard '232 explicitly requires collecting condensibles which comprise fullerene nanostructures and soot and separating the fullerene nanostructures from the soot. Therefore, Howard '232 teaches separating a solids from solids, solids from liquids, or liquids from liquids. Howard '232 does not teach separating at least a portion of suspended soot particles (solids) from a gas stream comprising gaseous fullerenes, as required by claims 51, 91, and 122.

This is consistent with the exemplary separation techniques provided in col. 7, lines 62-65 of Howard '232. Bag filtration, electrostatic separation and cyclone separation can all separate larger sized solids from smaller sized solids. For example, bag filtration can separate large sized solids from smaller sized solids by an appropriate choice of the bag filter.

There is no teaching or suggestion in Howard '232 that at least a portion of suspended soot particles (solids) can be separated from the condensable gases in the gas stream, where the condensable gases comprise gaseous fullerenes. As stated in the Background section of the present application, "it [was] not know whether fullernes are formed in the condensed phase . . . or whether they are formed in the gas phase and subsequently consumed by and/or embedded within the soot particles or agglomerates. Methods in the current art involve energy addition in solvent extraction, sublimation or other post-formation process steps to release the embedded fullerenes." (Page 4, line 20 through page 5, line 2). Without knowledge when the fullerenes form, it would not have been obvious to one of ordinary skill in the art that separation of gas from solids can be performed from the teachings of Howard '232.

Accordingly, claims 51, 91, and 122 would not have been obvious to one of ordinary skill in the art in light of Claim 1 of Howard '232. Reconsideration and withdrawal of the rejection is respectfully requested.

VII. Rejections under 35 U.S.C. §102(b)

As described above, Howard '232 teaches collecting condensibles which comprise solid/liquid fullerene nanostructures and solid/liquid soot and separating the solid or liquid fullerene nanostructures from the solid or liquid soot. Howard '232 fails to describe or suggest

separating at least a portion of suspended soot particles (solids) from a gas stream comprising gaseous fullerenes.

The Office Action further points to col. 7, line 66 to col. 8, line 30 of Howard '232 as evidence of Howard '232 teaching a gas/solids separation. However, the methods described therein describe dissolving solid fullerenes in a solvent and separating the dissolved fullerenes from undissolved solid soot. For example, col. 7, line 66 to col. 8, line 15 of Howard '232 describes a method utilized to deposit solid fullerenes and soot particles onto a copper grid for examination by transmission electron microscopy (HRTEM). The filtration described at col. 8, lines 13-15 of Howard '232 separates fullerenes dissolved in a solvent (*i.e.*, in liquid form) from solid soot particles and is not a solids-gas separation. Similarly, the separation (soxhlet extraction) described at col. 8, lines 16-30 of Howard '232 is a method to dissolve fullerene particles in a solvent and separate out the dissolved fullerenes (*i.e.*, in liquid form) from the solid soot residues. It is not a separation of solid suspended soot particles from the gas stream comprising gaseous fullerenes as required by the claims.

Accordingly, Howard '232 fails to describe or suggest the claimed invention. Reconsideration and withdrawal of the rejections is respectfully requested.

VIII. Rejections under 35 U.S.C. §103(b)

The Office Action further rejects claims 51-55, 59-93, and 122 under 35 U.S.C. §103(a) over Howard '232 in view of Applicants' admissions and claims 57, 58, 66, and 67 under 35 U.S.C. §103(a) over Howard '232 in view of Greico et al. Applicants respectfully disagree.

Greico et al. does not remedy the deficiencies described above. Greico et al. also teaches collecting soot, PAH, and fullerenes in the form of solids (see page 599, first full paragraph of Greico et al.) and does not teach or suggest separating suspended soot particles from a gas stream which contains gaseous fullerenes, either alone or in combination with Howard '232.

Moreover, Applicants are unclear as to which "Applicants' admissions" form the basis of the rejections. In particular, the Office Action simply states that "[a]s to Claims 51, 91 and 122, the rejection under 35 USC 120(b) is relied upon," (page 11 of Office Action) and nothing

further is stated. As stated above, Applicants have explicitly pointed out in the Background section of the instant specification that it was *not* known whether fullerenes form in the condensed phase or are formed in the gas phase (see page 4, lines 20-22 of the specification).

Accordingly, Applicants submit that independent claims 51, 91, and 122 are allowable for at least the reasons stated above. Applicants submit that claims 52-90, which directly or indirectly depend on independent claim 51, and claim 92, which depend on independent claim 91, are also allowable for at least the reasons stated above. Reconsideration and withdrawal of the rejections is respectfully requested.

IX. Restriction Requirement

For at least the reasons described above, Applicants submit generic claim 122 is allowable. Accordingly, Applicants request the Examiner to also consider claims 1-50 and 117-121, which the Examiner has asserted as belonging to a different species. Upon consideration, Applicants submit claims 1-50, 120, and 121 are also allowable for at least the reasons stated above. Applicants further submit that the cited references fail to describe or suggest the method of processing fullerenes as claimed in claims 117-119.

X. Information Disclosure Statement

As requested by the Examiner, the international search report for PCT/US2003/021301 is being submitted herewith.

VIII. Conclusion

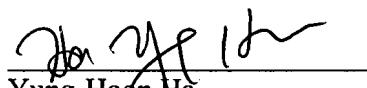
Applicant wishes to clarify for the record, if necessary, that the claims have been amended to expedite prosecution and/or explicitly recite that which is already present within the claims. Any narrowing amendments made to the claims in the present Amendment are not to be construed as a surrender of any subject matter between the original claims and the present claims; rather merely Applicant's best attempt at providing one or more definitions of what the Applicant believes to be suitable patent protection.

Applicants are submitting herewith a petition for a one-month extension of time with the payment of the requisite fees. As such, this response is being timely filed. In the event that additional extensions of time are required, the Commissioner is requested to grant a petition for that extension of time, which is required to make this response timely. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to Deposit Account No. 08-0219.

In view of the above amendment and remarks, Applicants believe the pending application is now in condition for allowance. Early notification of such is earnestly solicited.

Respectfully submitted,

Dated: April 9, 2007



Yung-Hoon Ha
Registration No.: 56,368
Agent for Applicant(s)

Wilmer Cutler Pickering Hale and Dorr LLP
60 State Street
Boston, Massachusetts 02109
(617) 526-6000 (telephone)
(617) 526-5000 (facsimile)

Attachments